Survey on Classification of Brain Tumor using Wavelet Transform and PNN

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***Abstract*— This paper presents, a new method for Brain Tumor Classification using Probabilistic Neural Network with Discrete Wavelet Transformation is proposed. Human inspection was the conventional method available for computerized tomography, magnetic resonance brain images classification and tumor detection. The classification methods that are operator assisted are impractical incase of large amount of data that are also non reproducible. Operator performance leads to serious inaccuracies in classification by producing noise in Computerized Tomography and Magnetic Resonance images. Neural Network techniques has shown great potential in the field of medical diagnosis. Hence, in this paper the Probabilistic Neural Network with Discrete Wavelet Transform was applied for classification of brain tumors. Classification was performed in two steps, i) Dimensionality reduction and Feature extraction using the Discrete Wavelet Transform and ii) classification using Probabilistic Neural Network (PNN). Evaluation was performed on image data base of Brain Tumor images. The proposed method gives better accuracy when compared to previous methods of classification.**

***Index Terms*— Brain tumor image classification, Discrete Wavelet Transform, Probabilistic Neural Networks (PNN).**

I. INTRODUCTION

Image processing is an essential step in medical images for subsequent image analysis tasks. Some of the issues that make medical image processing difficult, particularly in brain magnetic resonance imaging(MRI) are intensity in homogeneity or bias field and partial volume problem .Many processing techniques have been developed by researchers with the help of physicians and neurosurgeons to investigate and diagnose the structure and function of the brain. Brain consists the three soft tissues such as gray matter (GM), white matter (WM), and cerebro-spinal fluid. Any other soft tissue like brain tumor along with above soft tissues can be imaged using magnetic resonance imaging(MRI) .Ideally for any given set of MRI parameters the intensity values of pixels of any given tissue class should constant or correspond to a Gaussian distribution with a small standard deviation. This has motivated the need for image processing techniques that are robust in application involving a broad range of brain MRI images.

A group of abnormal cells that grows either inside the brain or around the brain are known as Brain tumor .Tumors can directly destroy all healthy brain cells. Indirect damage to healthy cells by crowding other parts of the brain and causing irritation, brain swelling and pressure within the skull is also one of the results of brain tumor.

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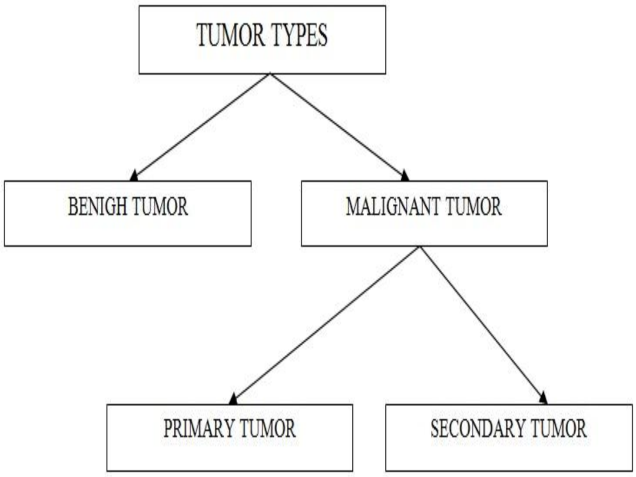


Fig. (a)Types of Tumor

Replace for patterns to enter and stabilize among each other. The brain is a soft, spongy mass of tissue. It is protected by bones of skull. This fluid flowed through the spaces between the meanings and through spaces within the brain called ventricles. Messages are carried back and forth between the brain and the rest of the body by nerves. Some go directly from brains to eyes, ears and other parts of the head. Other nerves run through the spinal chord to connect the brain with other parts of the body.

II. LITERATURE REVIEW

Most of the review has been done with the help of IEEE journals and transaction which is very authentic research work. With the help of review of literature, it was possible to choose the title of project according to the recent trends.

D.Sridhar and Murali Krishna et al. (2013) presented a new method for Brain Tumor Classification using Probabilistic Neural Network with Discrete Cosine Transformation is proposed. The use of Neural Network techniques shows great potential in the field of medical diagnosis.

S. Parisot et al. (2012) propose that a novel approach for detection, segmentation and characterization of brain tumors. Their method exploits prior knowledge in the form of a sparse graph representing the expected spatial positions of tumor classes .

Varada S.Kolge et al. (2012) presented that Probabilistic Neural Network with image and data processing techniques was employed to implement an automated brain tumor classification. Probabilistic Neural Network gives fast and accurate classification and is a promising tool for classification of the tumors.

Mohd Fauzi Othman et al. (2011) presented that Conventional methods of monitoring and diagnosing the diseases rely on detecting the presence of particular features by a human observer. The use of artificial intelligent techniques like neural networks, and fuzzy logic has shown great potential in this field.

Nojun Kwak et al. (2002) suggested that Feature selection plays an important role in classifying systems such as neural networks (NNs). The combined algorithm performed well in several experiments and should prove to be a useful method in selecting features for classification problems.

III. Discrete Wavelet Transform

The CWT measures the similarity between the wavelet and the signal by continuously shifting and scaling the mother wavelet providing a time-scale representation. Hence, an infinite number of wavelets are required. This proceeds insightful, produces highly the signal with a wavelet function. Hence the wavelet transform can be realized using linear filters since the compression in the time domain corresponds to stretching and shifting a function's spectrum, each wavelet is equivalent to a band-pass filter. Thus the wavelet family a series of scaled wavelets, can be formed using a series of filters. When dilation of wavelet is only considered for the powers of two, it is known as a dyadic. For the dyadic case a time compression by a factor of 2 stretches the frequency spectrum of wavelet factor of 2and also shifts the frequency components by a factor of 2. Accordingly, each wavelet covers a distinct range of frequencies with a bandwidth reduction at each step. An infinite number of wavelets are required to cover the entire spectrum in order to account for DC. The combinations of scaling functions and wavelets can thus cover the entire range.

The discrete wavelet transform (DWT) yields a fast computation of wavelet transform through a series of filters. The DWT is realized through successive low pass and high pass filtering of the Discrete time signal, three level wavelet decomposition.

IV. Probabilistic Neural Network

A suitable method for pattern classification is a type of Radial Basis Function (RBF) network, which is Probabilistic Neural Network. The basic structure of a probabilistic neural network is shown in fig. (b).

The fundamental architecture has three layers, an input layer, a pattern layer, and an output layer. The pattern layer constitutes a neural implementation of a Bayes classifier, where the class dependent Probability Density Functions (PDF) are approximated using a Parzen estimator.

Parzen estimator determines the PDF by minimizing the expected risk in classifying through the training set incorrectly. As the number of training samples increases, the classification gets closer to the true underlying class density functions using the Parzen estimator. Corresponding to each input vector in the training set the pattern layer consists a processing element. Equal number of processing elements lie with each output class otherwise a few classes may be inclined falsely leading to poor classification results.

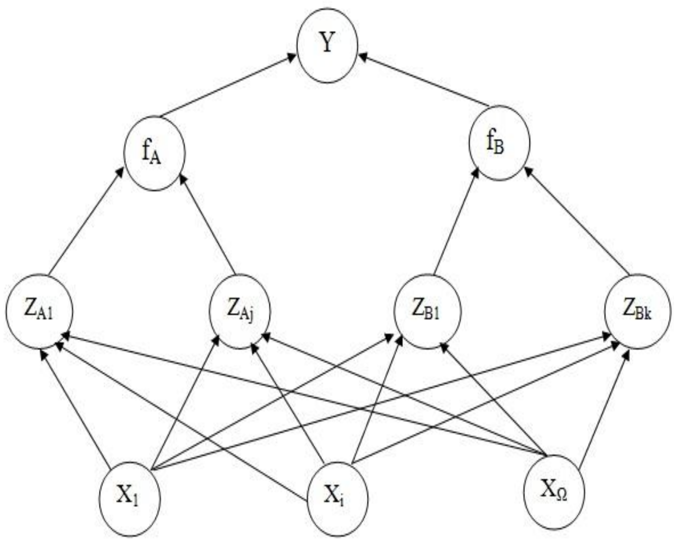


Fig. (b) Architecture of Probabilistic Neural Network

Each processing element in the pattern layer is trained once. When an input vector matches the training vector elements are trained to return a high output value. In order to obtain more generalization a smoothing factor is included while training the network. The pattern layer classifies the input vectors based on competition, where only the highest match to an input vector wins and generates an output. Hence for any given input vector only one classification category is generated. No output is generated if there is no relation between input patterns and the patterns programmed into the pattern layer.

Classification is done on the basis of Bayesian theory in probabilistic neural networks, the input vectors are classified into one of the two classes in a Bayesian optimal manner. It may be worse to misclassify a vector that is actually a member of class A than it is to misclassify a vector that belongs to class B as this theory provides a cost function. The Bayes rule classifies an input vector belonging to class A as,

$$P_A C_A f_A(x) > P_B C_B f_B(x)$$

Where,

P_A - Priori probability of occurrence of patterns in class A

C_A - Cost associated with classifying vectors

$J_A(x)$ - Probability density function of class A

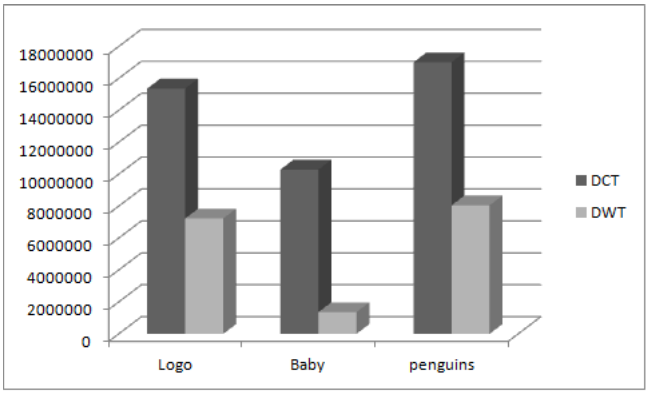
Brain tumor image database is shown in figure 4 and its normalized version is shown in figure 5. Before doing simulation size of the brain tumor images are reduced to 4 x 4. These reduced size images are used as inputs to the Discrete Wavelet Transform.

V. Comparison between DCT and DWT techniques

Result analysis comparison between DCT and DWT techniques

For DCT technique we can achieve the Cr=1.6 compression ratio.

For DWT technique we can achieve the Cr=1.9 to 2.3 compression ratio.



VI. CONCLUSION

The previously available technique that is Discrete Cosine Transform was not as efficient for the feature extraction, detection and classification of Brain Tumors despite of being very fast but not very much efficient with accuracy which is the utmost requirement here. Hence with the usage of Discrete Wavelet Transform we can achieve further improvement.

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